Journal of Research in Medical and Dental Sciences
2018, Volume 6, Issue 2, Page No: 563-567

Available Online at: www.jrmds.in
eISSN No. 2347-2367: pISSN No. 2347-2545

Evaluation of Lingual Mandibular Depression of the Submandibular Salivary Glands Using Cone-Beam Computed Tomography

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DOI: 10.5455/jrmds.20186286

ABSTRACT

The current study aimed at evaluating the depth and angle of concavity of the lingual depression of the submandibular salivary glands, based on the sex, age, and side of the mandible. A total of 200 CBCT scans (400 sides of mandible) were acquired; the deepest regions of the submandibular gland fossa and the concavity angle between the alveolar crest and the upper wall of the infra-alveolar canal were measured. The statuses of the deepest regions of the fossa, compared with the infra-alveolar canal were categorized into 3 groups. Moreover, the starting point of the concavity between the alveolar crest and the infra-alveolar canal was evaluated. The mean ± SD of the depth of the submandibular gland fossa on the right side in males and females were 0.83±2.02 and 0.57±1.73 mm, and those on the left were 0.82±1.99 and 0.61±1.66 mm, respectively. Furthermore, the concavity angles on the right side in males and females were 10.1±42.8° and 9.0±42.4°, and those on the left side were 10.4±44.6° and 8.0±41.6°, respectively. There was a direct relationship between the submandibular gland fossa depth and the concavity angle. The deepest region in both sexes was above the infra-alveolar canal and the greatest starting point of concavity was found in the middle one-third of the space between the alveolar crest and the upper wall of the alveolar canal. During implant treatments, evaluation of alveolar bone thickness in the submandibular gland fossa, especially in males, is of great importance.

Key words: Cone-Beam Computed Tomography, Mandible, Dental Implants, Salivary Glands, Anatomy

HOW TO CITE THIS ARTICLE: Sina Haghanifar, Nazanin Arbabzadegan, Ehsan Moudi, Ali Bijani, Farideh Nozari, Evaluation of Lingual Mandibular Depression of the Submandibular Salivary Glands Using Cone-Beam Computed Tomography, J Res Med Dent Sci, 2018, 6 (2):563-567, DOI: 10.5455/jrmds.20186286

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Received: 07/01/2018
Accepted: 21/02/2018

INTRODUCTION

Currently, dental implants are widely accepted as a therapeutic method after tooth loss [1, 3]. The morphological features of the bone and the relationship between implants and vital anatomical structures are among the most important factors in implant planning, which, if not performed properly, may result in bone perforation, followed by inflammation, infection, mandibular fracture, and loss of the implant [2, 4, 5]. In the posterior mandibular region, the infra-alveolar canal and submandibular gland fossa are among the most important anatomic regions [3]. Moreover, the submental and sublingual arteries pass through this region [1, 6, 7]. Perforation of the lingual plate attached to the mylohyoid muscle can cause lingual nerve damage; in addition, perforation of the submylohyoid space can cause hemorrhage and infection, which may even penetrate into the para pharyngeal spaces [3, 8, 9].

There are different methods to assess anatomical areas, such as touching ridges, osteometry, and diagnostic casts; however, these are not applicable to the posterior mandible, because of the mylohyoid muscle [1, 2]. To evaluate the status of concavities and to select a proper fixture, it is necessary to employ an appropriate imaging technique, such as cone-beam computed tomography (CBCT), for surgical purposes [2, 10]. Different studies have employed various methods to evaluate the concavity status of the submandibular gland fossa and reported different results [1–3, 6, 8]. The current study aimed at determining and evaluating the concavity depth and the angle at the lingual mandibular depression of the submandibular salivary glands and its position in an Iranian population, based on the age, sex, and side of the mandible.

MATERIALS AND METHODS

In the current cross-sectional study, a total of 200 CBCT scans (400 bilateral mandibular images) acquired from the patients referred to a private clinic of oral and maxillofacial radiology in the North of Iran from 2014 to 2016 were evaluated. All patients had a complete or partial edentulous ridge on their posterior mandibles. All CBCT scans were performed using a Cranex 3D (Soredex/ Helsinki/Finland) apparatus, and subsequently evaluated by the Ondemand 3D Dental software. The exposure parameters were 6 mA, 89 kVp (voltage), 0.2 mm (voxel size), and 8×6 cm (field of view); the area from the occlusal plane to the posterior mandibular border was evaluated.

First, the status of the infra-alveolar canal was determined using a panorama image; subsequently, the submandibular gland fossa was evaluated in cross-sections at 1-mm intervals with 1-mm thicknesses, and the deepest regions of the fossa were determined. Subsequently, Line A was drawn in the sections to connect the upper and lower points of the submandibular gland fossa (Figure 1); Line B was drawn perpendicular to Line A from the deepest region of the submandibular gland fossa. Subsequently, the position of this region, compared with the infra-alveolar canal, was evaluated and categorized into 3 groups: above the canal (above Line E), at the same level as the canal (between lines E and F), and below Line F. Moreover, to measure the concavity angle, a line was drawn tangential to the upper point of the concavity and perpendicular to the horizon (Line C). Subsequently, a line was drawn tangential to the upper wall of the concavity connecting the upper and lower points of the submandibular gland fossa (Line D); the angle between lines C and D was measured using a software (ß Angle) (Figure 1). Moreover, a line parallel to Line E and tangential to the alveolar crest was drawn (Line G); accordingly, the distance between lines E and G was divided into 3 sections: the coronal one-third, middle one-third, and apical one-third; the starting point of the undercut was categorized into one of these sections (Figure 2).

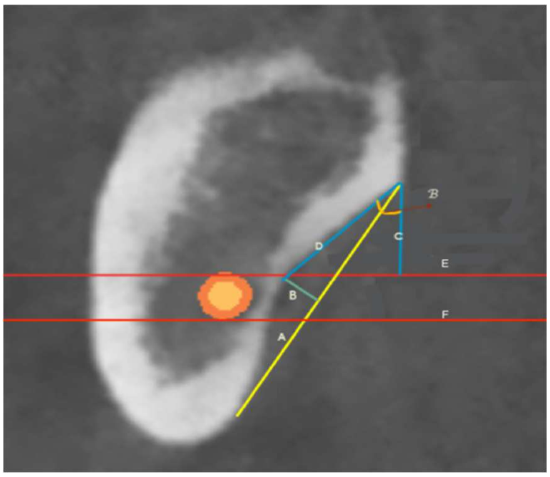

Figure 1: A cross-sectional view of the submandibular gland fossa

- **A)** Connecting the upper and lower points of the submandibular gland fossa
- **B)** The deepest point of the submandibular gland fossa is perpendicular to Line A
- **C)** The line is perpendicular to the horizon and tangential to the upper point of the submandibular gland fossa
- **D)** Connecting the upper and deeper points of the submandibular gland fossa
- **E)** The line is tangential to the upper wall of the canal, and parallel to the horizon
- **F)** The line is tangential to the lower wall of the canal, and parallel to the horizon

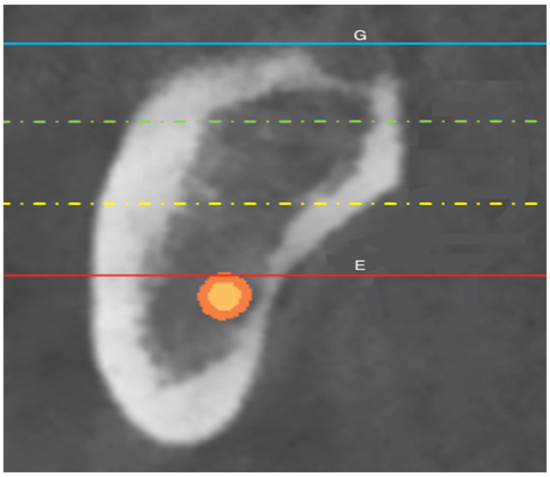

Figure 2: Categorizing the starting point of the undercut

Subsequently, the data were analyzed using SPSS version 17; the *t* test (to compare the mean values of both sexes), Pearson correlation coefficient (to determine the depth/angle ratio of the concavity), Kappa index (for the agreement of the deepest region of the fossa in both sexes), and the McNemar test (for the agreement of the deepest region of the fossa in both sexes) were utilized for the analysis. A P-value <0.05 was considered significant.

RESULTS

The mean age of the patients in the current study was 44.2 ± 12.7 years; 48.5% were male patients with a mean age of 40.1±12.4 years and 51.5% were female patients with a mean age of 48.5±11.6 years. The average submandibular glands fossa depths on the right and left sides of the mandible were 1.87± 0.72 and 1.87± 0.73 mm, respectively. The concavity angle on the right and left sides of the mandible were 42.63±9.59º and 43.09±9.42º, respectively. The average submandibular gland fossa depth and concavity angle are shown in Table 1, according to the side of the mandible and the sex.

The highest submandibular gland fossa depths on both sides of the mandible and both sexes were located above the canal, and no significant difference was observed between the sexes regarding the side of the mandible. The highest submandibular gland fossa depths, based on the side of the mandible and the sex, are shown in Table 2.

Table 1: The average submandibular gland fossa depth and concavity angle

	N	SEX	Mean±SD	P-Value
RCD^1	103	female	1.73±0.57	0.005
	97	male	2.02±0.83	
LCD^2	103	female	1.66±0.61	0.002
	97	male	1.99±0.82	
RCA^3	103	female	42.4±9.00	0.76
	97	Male	42.8±10.1	
LCA^4	103	female	41.6±8.00	0.027
	97	male	44.6±10.4	

a. Right Concavity Depth
b. 2. Left Concavity Depth
c. 3. Right Concavity Angle
d. 4. Left Concavity Angle
e. P-Value≤ 0.05

The most common starting point of the concavity was the middle one-third in both male and female patients. The frequencies of the starting point of the concavity, based on the sex and side of the mandible, are shown in Table 3.

In the current study, there was a direct relationship between the fossa depth and the concavity angle, in such a way that with increasing depth of the fossa, the concavity angle increased, and an increase in the age had no effect on the depth of the submandibular gland fossa and the concavity angle in male and female patients.

Table 2: The highest submandibular gland fossa depth

		R.P				L.P				
		Above	**Tangent**	**Blow**	**Total**	**Above**	**Tangent**	**Blow**	**Total**	**P-Value**
Male	N	51	40	6	97	56	36	5	97	0.66
	(%)	52.6%	41.00%	6.20%	100.00%	57.70%	37.10%	5.20%	100%	
Female	N	70	28	5	103	57	42	4	103	0.06
	(%)	68.00%	27.20%	4.90%	100%	55.30%	40.80%	3.90%	100%	
Total	N	121	68	11	200	113	78	9	200	0.54
	(%)	60.50%	34%	5.50%	100%	56.50%	39%	4.50%	100%	

Table 3: The starting point of the concavity on both sides of the mandible

		R.SOC				L.SOC				
		Above	**Tangent**	**Blow**	**Total**	**Above**	**Tangent**	**Blow**	**Total**	**P-Value**
Male	N	22	66	9	97	20	71	6	97	0.73
	(%)	0.227	68.00%	9.30%	100.00%	20.60%	73.20%	6.20%	100%	
Female	N	26	75	2	103	26	73	4	103	0.74
	(%)	25.20%	72.80%	1.90%	100%	25.20%	70.90%	3.90%	100%	
Total	N	48	141	11	200	46	144	10	200	0.88
	(%)	24.00%	71%	5.50%	100%	23.00%	72%	5.00%	100%	

DISCUSSION

In the current study, the mean values of the submandibular gland fossa depth were 2.02±0.83 and 1.73±0.57 mm in male and female patients, respectively; it was significantly higher in male patients than in female patients, indicating that the width and thickness of the bone at this point were less in male patients. According to the study by Panjnoush *et al.,* [2] Parnia *et al.,* [1] and Kamburoglu *et* al., [6] the average submandibular gland fossa depth in male patients was more than that of female patients. The average submandibular gland fossa depths in male and female patients in the current study were more than those in the study by Panjnoush *et al.,* [2] and less than those in the study by Parnia *et al.,* [1]; these differences may be attributed to the different methods of measurement, imaging techniques, and mainly, different anatomical features in different people. In the study by Chan *et al.,* [8], the average submandibular gland fossa depths were similar in male and female patients; this difference from the present study may be attributed to racial differences. In the current study, by increasing the submandibular gland fossa depth, the concavity angle increased, which in turn resulted in a higher average concavity angle in male patients.

However, in the study by Panjnoush *et al.,* [2], the average concavity angle was larger in female patients; this difference from the present study may be attributed to the different methods of measurement employed. In the study by Chan et al., [8] although the average submandibular gland fossa depths were similar for male and female patients, the average concavity angle was larger in male patients. In the current study, the linear and angular measurements on both sides of the mandible were compared between male and female patients; no significant differences were observed in the average submandibular gland fossa depth and the concavity angle between the right and left sides of the mandible. Moreover, with increasing age, no significant changes were observed in the average submandibular gland fossa depth and average concavity angle.

According to the results of the current study, the deepest point in most of the cases was above the dentoalveolar canal; hence, adequate knowledge regarding the morphological features of the region is important to prevent perforation of the lingual alveolar plate during implant treatment. Measuring the bone thickness at this point needs greater attention, compared to the alveolar ridge.

CONCLUSION

During implant treatments, evaluation of alveolar bone thickness in the submandibular gland fossa, especially in males, is of great importance.

Source of funding
This article presented the results of a research project in Babol University of Medical Sciences (by Grant No: 954218).

Conflict of Interest
None declared.

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